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AIDS TO MATHEMATICAL RESEARCH.

Royal Society of London, Catalogue of Scientific Papers, 1800–1900. Subject Index Vol. I. Pure Mathematics. Pp. lviii + 666. (Cambridge: University Press, 1908.) Price 21*s*. net.

THE output of the scientific world is now so great that considerable attention has been devoted of late to devising means of acquainting those engaged in scientific research with the results attained by other investigators. With the publication of the first volume of the Royal Society Index, the student of mathematics is now particularly well provided in this respect. No one work could provide for his needs, and in fact they are at present supplied by several publications. The helps which have been provided for him naturally fall into three groups. The first of his needs is a means of obtaining a rapid survey of any department of his subject which will make him acquainted with the principal writings on it. Numerous encyclopædic works have been published which aim at supplying this want, the most important being the "Encyklopädie der mathematischen Wissenschaften," which is at present in course of publication. A more important need is a means of following the course of current publications without an impracticable amount of reference to the papers themselves. This want is admirably supplied by the "Jahrbuch über die Fortschritte der Mathematik." This valuable work, which appeared first in 1871, gives abstracts of all papers dealing with mathematics which have appeared within a space of twelve months, but it does not appear until two years after the one with which it deals. The abstracts in this work are arranged by subjects and indexed under the authors' names.

Even the comparatively short delay in the publication of the "Jahrbuch" was found inconvenient, so in 1893 the Mathematical Society of Amsterdam arranged to publish the "Revue Semestrielle," a half-yearly list of papers, arranged according to periodicals, giving titles and a short indication of the subject-matter. Each paper is classified in accordance with an international code, and a subject-index is given as well as an authors' one. In addition to these, the "International Catalogue of Scientific Literature" has appeared annually since 1902, one volume being devoted to mathematics. In this work the papers of the previous year are arranged according to subjects, an index of authors' names being appended.

The above works are supplemented by two immense publications, Poggendorff's "Handwörterbuch zur Geschichte der exacten Wissenschaften," and the Royal Society's "Catalogue of Scientific Papers." The former, which consists of four volumes, gives the works of authors up to 1904, and includes physics, astronomy, chemistry and geology, besides mathematics; the latter covers a much larger range of subjects, and extends to twelve large volumes; its scheme is very similar to that of the "Handwörterbuch," but the volumes already published only extend from 1800 to 1883.

These works, though of incalculable value to the investigator, do not directly supply him with information on a given part of his subject, which is of course what he generally requires. Hitherto he has had to rely mainly on his own sagacity and experience, although of late many bibliographies have been published for special subjects. The book under review will materially lessen this part of the student's labour, and is bound to form an essential part of his scientific equipment; all the more so as it is extremely moderate in price, which cannot be said of any of the other works mentioned above with the exception of the "Revue Semestrielle."

When the "Catalogue of Scientific Papers" was projected by the Royal Society in 1857, the plan included a subject-index, and during the compilation of the published twelve volumes much material was amassed for this purpose. Its completion and publication was found, however, to involve more expense than could be met unaided by the Royal Society, and it is only lately that the funds at the disposal of the Royal Society have been so augmented by private donations as to admit of the completion of the work. The preface states that the Index is especially indebted to Dr. Ludwig Mond, F.R.S., in this respect.

The Index, which will include all papers published during the last century, is to appear in seventeen volumes, each of the volumes dealing with one of the sciences of the schedule of the "International Catalogue." The first volume of the series, which is the subject of this review, deals with pure mathematics. In it all papers on this subject published from 1800 to 1900 have been indexed under subjects, with the exception of about 750 short notes dealing principally with elementary geometry, which were not thought of sufficient interest to be entered. Any mathematician will at once recognise what immense labour this must have involved: the preface gives the number of entries as 38,748, referring to 700 serials.

The index of titles from 1884 to 1900 has been made by referees familiar with the subjects, who have made the titles from the contents of the papers and not merely from headings. Papers published prior to 1884 were not in all cases consulted, but a test made in a subject, with the literature of which the writer is familiar, seems to show that the value of the index has not suffered materially from this.

It is manifestly impossible to discuss here such a work as the Index in detail. Its value was therefore tested by comparison with a bibliography dealing with matrices. The comparison emphasised the difficulties of classification which are inherent to a work like this. In fact, papers dealing with the theory of matrices are scattered over some five or six different headings. This is a drawback which could not have been obviated without swelling the volume to an impracticable size by numerous cross-references, and after a little experience it causes less inconvenience than might be supposed. In some cases, however, the classification might have been easily improved upon. For instance, it is curious to find that the principal modern papers on hypercomplex

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numbers are classified under the heading "Other Special Sorts of Complex Numbers," while the older papers are properly classified under the heading "General." Again, Hamilton groups are classified under "Quaternions," and not as one would expect under "Groups." Occasionally the subdivision of headings is carried so far as to be a hindrance instead of a help. For instance, references to papers on matrical equations are scattered over five separate headings, instead of being under one heading with two or three subheadings. Several short notes also have been omitted which might well have found a place. A short note appearing early in the development of a subject is of more importance than a similar one appearing at a later stage. If it was impracticable to classify all such notes minutely, they might have been given under the main headings without any subclassification.

Another difficulty which is likely to occur now and again in the use of the Index is that occasionally short papers are published for the first time in the collected works of an author. Such papers are not classified in the Index, which only includes periodicals in its list. In the case of matrices, too, several interesting accounts of the subject have appeared as appendices to treatises having no direct connection with this subject except in so far as matrices are required for some portions of the analysis. Such articles are of course not indexed, although they are sometimes of some importance.

Such criticisms of detail might no doubt be carried much farther; they affect, however, only points of comparatively small importance, and do not affect materially the great service which the Index will render to the mathematical public. At a moderate estimate it will lessen the labour of forming bibliographies, or of hunting up references, by considerably more than one-half. An exceedingly useful feature of the work is a list of periodicals which gives the names of the principal British libraries in which they are to be found. This should effect a great saving of time for those who are not so fortunate as to be situated close to any of our principal libraries.

The Index is published by the Cambridge University Press, and, as is usual in books published by them, the printing leaves nothing to be desired.

MODERN MARINE ENGINEERING.

Marine Engineering (a Text-Book). By Engineer-Commander A. E. Tompkins, R.N. Third edition, entirely re-written, revised, and enlarged. Pp. viii +812. (London: Macmillan and Co., Ltd., 1908.) Price 15*s.* net.

MARINE engineering has been developed in many directions during recent years, and the influence of these developments upon the design of steamships has been marked. Within a period of fifteen or sixteen years water-tube boilers have practically taken the place of cylindrical (or "tank") boilers in all classes of warships; steam-turbines have been introduced for ship-propulsion, and have already superseded reciprocating engines in the Royal Navy, while growing in favour in other war-fleets and in mercantile steamships; oil-fuel has been adopted as a supplement to or substitute for coal; and now internal-combustion engines are being introduced and greatly increased in size and power. It is a natural consequence of these changes that numerous additions should be made to the literature of the subject, and that new editions of standard text-books should appear.

Among these text-books, intended primarily for the use of students, the work under review holds a distinguished place. The author is an experienced engineer officer of the Royal Navy, who has served long at sea in charge of machinery, and has also been occupied for some time as instructor and lecturer in marine engineering at the Royal Naval College, Greenwich, and the Royal Naval War College. At both these establishments he had to do chiefly with naval officers, whose technical knowledge of engineering was much the same as that of students beginning work on the subject. He has consequently given explanations of both theory and practice in simple language, which makes the book serviceable, not only to students of marine engineering, but to general readers desirous of obtaining acquaintance with modern methods and the most recent designs of marine engines and boilers. This third edition is virtually a new book—re-written and considerably larger than its predecessors—bringing information up to date. It deals briefly with types of boilers and machinery which have been made obsolescent by the progress of recent years, and aims at the presentation of "a summary of the best practice of the present day." It is but justice to the author to say that this intention has been realised.

The theory of thermodynamics is treated in an elementary manner, and its applications to the formation and expansion of steam are explained. One section is devoted to marine boilers, and the various types of water-tube boilers now in use are fully described. Another section treats of combustion, giving details of the methods adopted for efficiently burning coal and liquid fuel, and particulars of the various kinds of liquid fuel now in use. The conclusions reached by the author are that, for a given weight of coal and oil, oil gives from 25 to 30 per cent. greater energy, reduces the space for stowage by 10 per cent., makes it much easier to replenish fuel-supplies, and decreases the number of firemen by 50 per cent. The determining factor in regard to the extended use of oil-fuel is now, as it has been for the last twelve years, the question of adequate supplies at reasonable rates. Reciprocating engines still hold the field in the mercantile marine, and are described at length in their latest forms. Condensers, evaporators, feed-water systems, superheaters, and other accessories also come under review; and so does auxiliary machinery of various kinds—including steering and capstan engines, refrigerating apparatus, air compressors, hydraulic machinery, electrical apparatus, and other classes of machines, all of which are essential to the efficient working of a modern steamship. The care and management of propelling

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